Project of Time Series Analysis in Financial Mathematics

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1. Unit Root Test:

In unit root testing,pp test or adf test both works. I choose the ADF test.

Here is the code of ADF test:

```
y=('fredgraph Dec11unitroottestV2.xls');
a=xlsread(y)
[h,pvalue]=adftest(a(:,1));
```

The input file includes the following variables:

1) GDP level
2) CPI level
3) unemployment rate
4) consumption level
5) exports
6) M2

The outputs are P-value, hypotheses, and a result that shows whether it is a unit root or stationary. There results are showed in table 1 in the excel.

Because some of the p-values are bigger than critical value (0.05). They need to be differentiated until the their results in ADF test can be <=0.05. I use the formula: $dx_i=LN(x_i)-LN(x_{i-1})$ to calculate the differentiation of these variables:

1) differentiation of GDP level
2) differentiation of CPI level
3) differentiation of consumption level
4) differentiation of exports
5) differentiation of M2

Then I ran the ADF test again.

The new outputs can be seen in table 1 in the excel report as well.

2. BVAR test

The aim is to find out which way of forecast is better, among Minnesota and Independent Normal-Wishart. The point is to compare two values of RMSE. RMSE shows how big the error of a prediction strategy is, compared with the actual value. The smaller the RMSE is, the more accurate the forecast strategy is.

The input file includes variables:

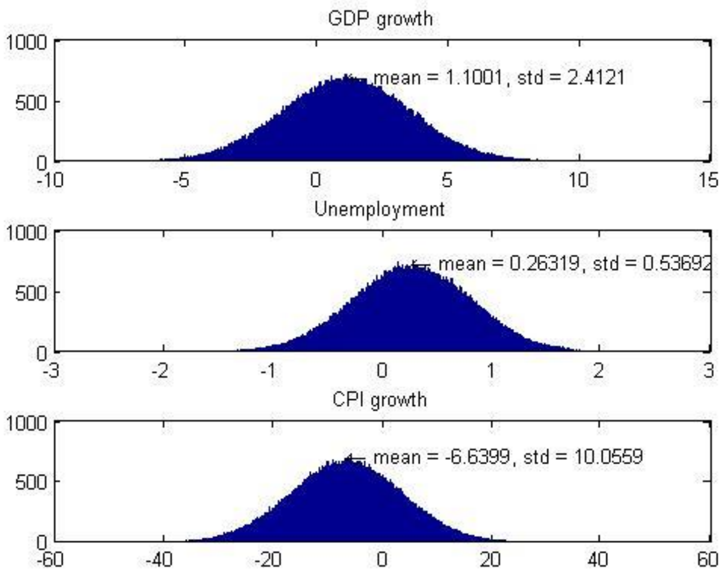
1) GDP growth
2) CPI growth
3) unemployment rate

4) 10 year rate
5) 3 month rate
6) M2
7) exports

I set Impulses=0, prior=2 (Minnesota). Then I ran the BVAR_FULL program. After running, in the command window, if I type in "Y_pred" , the predicted value can be called. This variable Y_pred is going to be used in the RMSE calculation. In order to get RMSE, I built up a new file in matlab and write the program of calculation. The loop goes from 73rd row to 133rd row. Because I calculated the variables from 2001 to 2016. This is more accurate than calculating from 1983 to 2016. Because the time period is shorter and the error is smaller.
The formula of RMSE is: RMSE= square root of ((1/T)*sum of (($x_{predicted}$- x_{actual})^2))
Here is the code to calculate RMSE:

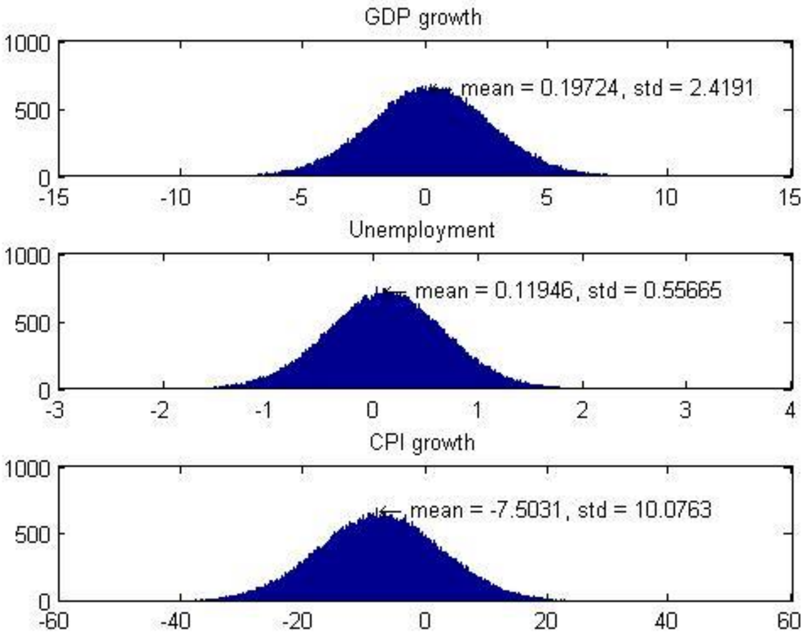
```
i=0;
RMSE=0;
k=0;
for(k=1:7)
for(i=73:133)
    RMSE=RMSE+(Y_pred(i,k)-Yraw(i,k))*(Y_pred(i,k)-Yraw(i,k));
end
    RMSE=RMSE/60;
    RMSE=sqrt(RMSE);
    RMSE
    RMSE=0;
End
```

The result of RMSE can be seen in table 2 in the excel report. The distribution can be seen in Figure 1
Figure 1 impulse=0 prior=2



Then I set impulses=0, prior=4 (Independent Normal-Wishart). I ran the BVAR_FULL program. I get the variable Y_pred. After that, I ran the program "RMSECalculation"
The result of RMSE can be seen in table 2 in the excel report. The distribution can be seen in Figure 2

Figure 2 impulse=0 prior=4



Finally, the conclusion can be drawn. Among the RMSE in 6 variables, for 4 variables, prior=4 gives a higher accuracy. For the other 2 variables, prior=2 gives a higher accuracy. This means that, in the most of the cases, prior=2 (Minnesota) is better than prior=4 (Independent Normal-Wishart). Therefore I choose prior=4.

3. Impulse Calculation
In this calculation, the variable impulses=1. The variable prior equals to a value that leads to the smallest RMSE. So prior=4. The result can be seen in the Figure 3 and Figure 4.

Figure 3 impulse=1 prior=4

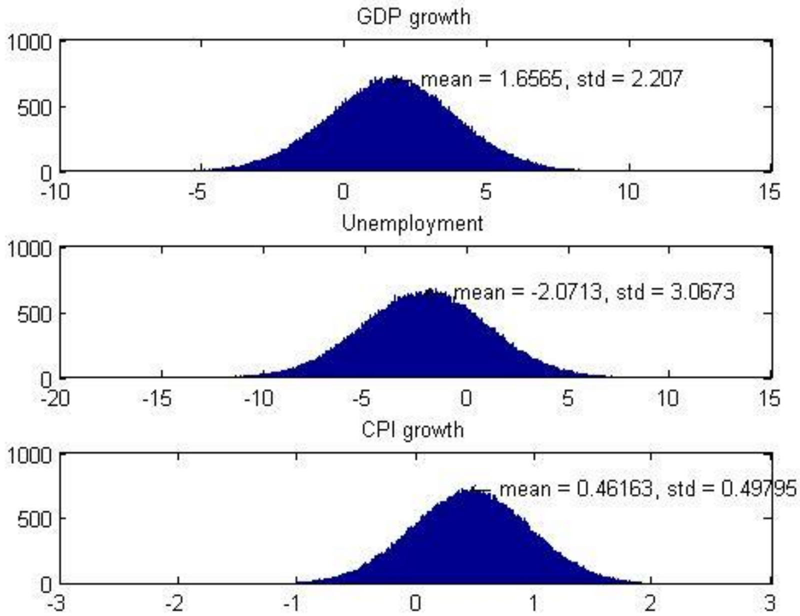


Figure 4 impulse impulse=1 prior=4